



GARDEN AT CROSS LAKE, NELSON RIVER.



FALLS OF MUHIGAN RIVER.

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GEOLOGICAL SURVEY OF CANADA  
ROBERT BELL, M.D., Sc.D. (CANTAB.), LL.D., F.R.S.

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REPORT

ON

1902 EXPLORATIONS IN THE NORTH-EASTERN PORTION

OF THE

DISTRICT OF SASKATCHEWAN

AND ADJACENT PARTS OF THE

DISTRICT OF KEEWATIN

BY

J. BURR TYRRELL, M.A., B. Sc.



OTTAWA

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To the Director,  
Geological Survey of Canada.

SIR,—I have the honour to present my report on the north-eastern portion of the district of Saskatchewan, and part of the adjoining district of Keewatin.

I have the honour to be, Sir,  
Your obedient servant,

J. BURR TYRRELL.

NOTE.—Mr. Tyrrell's manuscript report was accompanied by a tracing of his routes on a scale of two geographical miles to an inch. This was incorporated by Mr. Dowling in the map which illustrates the report.—R. B.

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**NOTE.**—*The bearings given in this report refer to the true meridian throughout.*

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REPORT  
ON THE  
NORTH-EASTERN PORTION  
OF THE  
DISTRICT OF SASKATCHEWAN  
AND ADJACENT PARTS OF THE  
DISTRICT OF KEEWATIN

BY  
J. BURR TYRRELL, M.A., B. Sc.

INTRODUCTION.

The rivers and lakes described in this report form the chief canoe-  
routes or lines of travel at present available through a tract of Area covered  
by report.  
country with an area of rather more than twenty-five thousand square  
miles, lying between north latitude  $50^{\circ} 40'$  and  $56^{\circ}$  and west longitude  
 $97^{\circ} 20'$  and  $102^{\circ} 30'$ ; bounded on the south by Lake Winnipeg and  
Saskatchewan river on the east by Nelson river, and on the north and  
west by ~~L~~ Wood and Churchill rivers.

The exploration was accomplished during the summer of 1896, the  
writer taking a canoe and two men from Selkirk, Manitoba, and  
occasionally employing natives in their own canoes as guides. No  
surveys of the interior portion of the country having been made  
the routes followed were surveyed as accurately as the time and  
means at my disposal would permit. The distances on running water  
were estimated by the rate of travel, and on quiet water they were  
measured with a Massey floating boat-log. Where local attraction  
was suspected the bearings were taken with a solar compass, but where  
no local attraction was detected they were taken with a prismatic  
card compass. As often as possible observations for latitude were  
made with a sextant of eight inch radius.

Total length  
of survey.

These surveys were for the most part carefully plotted in the field on the scale of two geographical miles to one inch, ready to be reduced to a map of any desired size. The total length of survey thus made amounts to seven hundred miles.

The character of the rocks and soils was carefully noted on the above lines of survey, and some additional information was gained about the geology of the banks of Nelson river as far down as the outlet of Sipiwek lake, and of the valley of the Saskatchewan river from Cumberland House up to Fort à la Corne. For assistance in the microscopical determination of some of the rocks, the writer is indebted to Dr. A. E. Barlow of this Survey.

Topography.

The general relief of the country is low and unpronounced, and the whole surface slopes somewhat evenly and regularly towards Hudson bay. The highest areas are near the Cranberry lakes, which have an elevation of about 935 feet above the sea, while the lowest are near Sipiwek lake on Shawenan falls, with an elevation of about 565 feet above the sea. Probably the most prominent feature of the district is the limestone escarpment which runs south of Grass river and the chain of lakes into which it expands; but this escarpment though steep and persistent did not seem to average more than fifty or sixty feet in height. East of Reed lake the hard granites, traps, &c., are buried beneath a thickness of from ten to a hundred feet of soft gray stratified clay. This clay has rarely been deposited in sufficient thickness to even up the original inequalities of the underlying rocky floor, but it commonly rises over the hills and descends into the valleys. In the bottoms of the deeper depressions are large or small lakes of slightly muddy water with rocky beaches from which the clay has been washed away, and sloping thickly wooded shores. These lakes are connected and drained by rivers which, in places, flow with a gentle current between low banks of clay, and then pitch down steep rapids or cataracts over ridges of the underlying Archean rocks. Occasionally the streams have cut narrow valleys from ten to eighty feet in depth through the stratified clay to the highest points of the underlying rocky floor.

Timber.

The surface is generally forested, though most of the valuable timber has been destroyed by fire. On the Grass, Muhigan and Minago rivers, as well as on the shores and islands of some of the lakes, there are still some forests of excellent white spruce, but on the northern part of Lurntwood river white spruce is rather scarce, and at Nelson House, timber for house logs has to be collected from scattered groves and brought several miles up or down the brooks or across the lake.

Black spruce and canoe birch grow on the more level and imperfectly drained tracts, and Banksian pine may be seen here and there on the drier hill-sides. Canoe birch grows to a good size beside the lakes and streams, but aspen (*Populus tremuloides*) is the commonest deciduous tree, as it grows on the drier uplands everywhere, occasionally forming beautiful forests, but more often, and especially towards the north, partly covering the surface with scattered groves of small trees.

Among the smaller trees or shrubs, the rowan tree (*Pyrus Americana*) may be mentioned as growing freely and having an abundant crop of berries along the face of the limestone escarpment, especially around Wekusko and Reed lakes, and the wild cherry (*Prunus Virginiana*) grows besides most of the lakes. Many of the smaller fruits grow on the clay-covered country in great profusion. Among those that were especially abundant were raspberries (*Rubus strigosus*), gooseberries (*Ribes oxycanthoides*), red and black currants (*Ribes rubrum* and *floridum*), strawberries (*Fragaria Virginiana*), blueberries (*Vaccinium Canadense*), and headberries (*Rubus Chamamorus*). Small fruits in abundance.

Much of the land is well adapted for agriculture.\* At Norway House some fine barley had been sown and ripened in the garden, and all the ordinary vegetables grown in Manitoba have been raised for many years past. At Cross lake many of the Indians had good large gardens of potatoes and other vegetables, and McLeod and Melvor, two fur traders, had excellent gardens in which were growing potatoes, turnips, carrots, parsnips, radishes, cabbages, cauliflowers, onions, lettuce, beans, peas, etc. At Nelson House in the extreme northern part of the district explored, many of the Indians regularly grow potatoes, and both the fur traders and the missionaries cultivate small patches of ground on which they raise abundant crops of all the vegetables mentioned as growing at Cross lake. It is probable that the hardier varieties of grain† would also ripen here, but at present there is no object in growing grain of any kind for it could not readily be utilized. Suitable for agriculture.

The country is stocked with animals of various kinds. Moose are abundant in some of the more thickly wooded tracts. Black bears are somewhat numerous, and beaver, otters, martens, mink, musk-rats and red foxes are killed by the Indians in considerable numbers in Game plentiful.

\* In Dr. Bell's descriptions of this region, contained in the Reports of Progress of the Geological Survey for 1878, '79 and '80, contain much information as to the soil, timber, natural products, gardening, climate, etc., being the results of his explorations and observations in the country between the Winnipeg basin and Hudson bay and around the bay in general.

† Wheat ripens well at Norway House and Cross lake, on the Nelson river.—R.B.



the aggregate every year. White fish (*Coregonus clupeiformis*) abound in most of the lakes and streams, while the lake trout (*Salvelinus namaycush*) seemed to be moderately plentiful in the clear lakes near the head of Grass river. Of the other fish the sturgeon (*Acipenser rubicundus*) and pickerel (*Stizostethium vitreum*) are the most important.

Indian  
inhabitants.

The region was known among the early fur traders as the Muskrat country and was then thinly peopled by Cree (or Nahathaway) Indians, who were scattered along the banks of the many lakes and streams. The descendants of these nomadic Indians are now collected on Reserves or about Missions and trading stations at the following places, viz: Pelican narrows, Cumberland House, The Pas, Grand Rapids, Ross-villa, near Norway House, Cross lake and Nelson House. At these places they spend the summer, living on the fish they may be able to catch in their nets and such supplies as they can borrow or earn from the traders. During this portion of the year the surrounding forest is entirely deserted. In the autumn the Indians scatter into the woods, each man with his family choosing a tract over which he proposes to hunt, and pitching his tent or building his little log shanty beside a lake, he endeavors to catch sufficient fish to feed his family and dogs through the winter before the lake sets fast with ice, after which he devotes his time to trapping the fur-bearing animals or hunting moose.

During the summer of 1896 no frost occurred until the 29th of August. At Nelson House we were informed that, during the preceding seven years at least, no frost that would injure garden produce had occurred at an earlier date. Footprint lake, in the extreme northern portion of the district, was stated to freeze over as a rule between the first and the middle of November, and to remain frozen until about the twenty-fourth of May.

#### GEOLOGICAL CHARACTERS.

Geological  
formations.

The formations met with in the area under consideration are enumerated in the following table:—

Recent.  
Pleistocene.  
Agassiz clay.  
Eskers.  
Till, etc.

Silurian (Niagara.)  
Cambro-Silurian (Trenton.)  
Huronian.  
Laurentian.

*Recent.*

The most interesting recent deposits in the district are thick beds of *Peat beds.* peat, which extend northward from the shore of Lake Winnipeg, past Kiskittogisu lakes, overlying the level surface of the stratified Agassiz clays, that extend from the base of the limestone escarpment. In many places swamps are growing in the hollows and filling them with mossy peat, but this swamp seemed to be much more extensive than the others and it is certainly the most easily examined in the district. On the shores of the adjoining lakes the waves are rapidly cutting away the underlying clay, and fresh sections both of the clay and of the overlying peat are constantly brought to view. Similar cliffs of clay, overlain by peat were also seen around some of the lakes on Burntwood river.

The shore-lines of the lakes are usually rather strongly marked. *Shore-lines.* Where the lake lies in a rocky basin any clay that may have been over the rock has been washed away, and a smooth bare rocky beach is left. In other places a heavy wall of boulders has been packed back on the shore. Many of the bays have beaches of sand, or the land may descend in weedy slopes to the edge of the water. In the lower western portion of the rocky country, well defined valleys seemed to be entirely wanting, but further east, where the country has been covered by a considerable thickness of Agassiz clay, the streams have cut narrow valleys through the clay to the underlying rock, thus forming reaches of quiet river, separated by falls or short steep rocky rapids. The valleys are steep and narrow without terraces and usually without bottom-land, showing that they have been rapidly eroded in very recent times by streams of about the same size as those that now flow through them. The almost entire absence of current on Minago river from the head of Hill lake to its mouth would tend to show that the northern elevation of the land shown by the old beaches around the Winnipeg basin, and around Hudson bay, had not ceased before this valley was excavated.

## PLEISTOCENE.

Pleistocene  
clay.

Northward and north-westward from Lake Winnipeg the surface of the Archaean peneplain is covered by a coating of clay varying from a very few feet up to a hundred or more in depth. This clay seems to follow the larger contours of the underlying rock surface, descending into the valleys and rising over the hills, but it covers and obscures most of the minor inequalities. In composition it varies from a soft impervious blue clay to a light gray fine porous clayey silt, but it is everywhere evenly stratified, the lines of stratification being often coarse, but always strongly marked. Boulders were occasionally found imbedded in the clay, but they are almost invariably found in the lower layers where they have been dropped from the ice close to the retiring face of the glacier from the east. The eastern limit of these Agassiz clays, so called on account of having been deposited in the glacial Lake Agassiz, was found to be marked more or less closely by the channel of Nelson river, that stream having chosen its course along the line where the clay slopes gently down to the bare rocky surface of the Archaean rocks. The clays attain their greatest thickness along a line from Mossy point on Lake Winnipeg, bearing about N. 15° W., to Wuskwatim lake on Burntwood river, from which line they gradually decrease in thickness westward. Around Reed lake they nearly fill the rocky hollows, while around Cranberry lakes they seem to have entirely disappeared.

Origin and  
deposition.

The origin and mode of deposition of these clays is quite apparent. When the Keewatin glacier in its gradual retirement towards the north was joined by the glacier flowing from the east, the water derived from their melting was held between the united ice-front and the face of the Manitoba esarpment, and Lake Agassiz, a large extra-glacial body of water was formed. The eastern glacier advanced westward to within a short distance of Wekusko lake, and then began to retire. Streams draining the glacier carried a large quantity of sediment into the lake, and this sediment was spread over the smooth rocky bottom which had but recently been cleaned and polished by the passage over it of the two glaciers. This sediment was deposited in greatest thickness along the extreme edge of the glacier, for whatever may have been thrown down in front of the advancing glacier was again picked up by the ice, carried forward, and afterwards redistributed in the lake. Farther from the front of the glacier, the sediment became fine and smaller in amount, just as is seen to be the case on ascending Burntwood or Grass rivers. From the extreme western

line to which the eastern glacier reached, the Agassiz clays were deposited eastward, as the glacier gradually retired, as long as the extra-glacial Lake Agassiz existed, and as the clays do not seem to extend any considerable distance east of Nelson river, Lake Agassiz was evidently drained when the eastern glacier had retired to that line.

No distinct shore lines of Lake Agassiz were definitely determined in this district, but it is probable that the sandy plain over which Cranberry portage runs, was formed at or near the shore of the lake at one of its stages. One would not expect to find the old shore lines which marked the eastern side of the lake; nevertheless the existence of an esker, such as that below the Sea River falls on the Nelson river, gives abundant evidence, if such were needed, that Lake Agassiz had almost entirely disappeared when the eastern glacier had retired east of Nelson river. This esker was formed in running water, between the icy walls of one of the streams flowing from the glacier, perhaps the one that brought down most of the sediment deposited south of the present Lake Winnipeg. If it were formed west of Playgreen lake it has doubtless been modified and spread out, perhaps to form the sand plain on the portage to Kiskittogisu river. Over the ridge at Sea falls there is no sign of the prevailing Agassiz clay, but that portion of the ridge west of the river may have been a delta formed at the mouth of the glacial river where the lake stood about forty feet above the present level of Lake Winnipeg. The sandy ridges at the south-west end of Cross and of Sipiwesk lakes are probably also combinations of kames and delta-plains at the termination of an esker, where the ancient lake stood at about the same level.

Till is remarkably scarce throughout the entire region, the whole rocky surface having been scraped very clean by either the Keewatin or eastern glacier or by both. Where till was seen it was almost always in the form of loose fragments of rock, mixed with sand and clay, dumped into the eastern side of some steep valley, or under the lee of some rocky cliff. Boulders are almost entirely absent from the surface of the country covered by Agassiz clay, but from Wekusko lake west to Cranberry lake they are moderately abundant on the rocky hills and on the shores of the lakes. No heavy or extensive moraines were recognised but a light moraine, consisting of a ridge of boulders of Archaean rocks runs along the brow of the limestone escarpment west of Reed lake, apparently formed when the face of the Keewatin glacier rested for a little while against the face of the escarpment.

Kettle holes formed by streams flowing from the Keewatin glacier occur in the gneiss on Kettle island in Playgreen lake and near the foot of a hill of massive granite on the west shore of Wintering lake. In each case the sides of the holes have been partially cut away since they were formed, perhaps in part by the Keewatin glacier itself and in part by the eastern glacier. These holes would indicate that an extra glacial lake existed in front of the Keewatin glacier where they were formed, but that the streams plunged down from the ice to the rocky floor and afterwards flowed away freely over the surface. As these holes are usually on the east or south-east sides of rocky hills, the position of the moulins into which the water plunged were doubtless determined by the existence of the hills, the ice having been more readily split or melted here than elsewhere.

**Kettle holes.** The surface of the Archean rises in gentle rounded knolls and ridges, apparently emerging from beneath the Palaeozoic limestone with about the same contour that the remainder of the surface has at present. The only difference remarked was that the softer, more highly altered chloritic and sericitic schists were more conspicuous along the foot of the limestone escarpment than elsewhere. Where they have been more exposed they have been eroded deeper than the surrounding rocks, and consequently occupy the beds of the lakes and other hollows. Most of the knolls are smoothed and marked with glacial striae. The striae in the western part of the region have been made entirely by the Keewatin glacier, which moved southward from the country west of Hudson bay, while those in the eastern part of the region have, with one or two exceptions, been made by the eastern glacier. On a belt a few miles in width, down the middle of the region both sets of striae can be clearly seen, crossing each other at a wide angle, the rocks of the eastern glacier over-riding and rubbing out those made by the Keewatin glacier. The direction of motion for both glaciers is unmistakable. How far east the Keewatin glacier extended has not yet been determined.

**Glacial striae.**

In the following list of glacial striae, the coarse of those made by the Keewatin glacier are printed in italics.

*List of Glacial Striae.*

|                                             |              |
|---------------------------------------------|--------------|
| Islands off Mossy point, Lake Winnipeg..... | S. 40° W.    |
| Nelson river, outlet of Lake Winnipeg.....  | S. 36-45° W. |
| " " " (earlier set).....                    | S. 5° E.     |
| Playgreen lake, Goose island.....           | S. 45° W.    |
| " 1 mile north of Goose island. ....        | S. 50° W.    |
| " north-west end... ..                      | S. 55° W.    |

|                                                         |               |
|---------------------------------------------------------|---------------|
| Playgreen lake, east shore, 3 miles from north end..... | S. 50° W.     |
| Little Playgreen lake, Rossville mission.....           | S. 52° W.     |
| " " Soulier point.....                                  | S. 52° W.     |
| " " mouth of Sepastic channel.....                      | S. 65° W.     |
| " " north end.....                                      | S. 40° W.     |
| Nelson river, 2 miles above Sea River falls.....        | S. 55° W.     |
| " Sea River falls.....                                  | S. 55° W.     |
| " latitude 54° 22'.....                                 | S. 40° W.     |
| " first portage above Pipestone lake.....               | S. 40° W.     |
| " Gabbro island, Pipestone lake.....                    | S. 50° W.     |
| " island below Pipestone lake.....                      | S. 50° W.     |
| " " " (earliest).....                                   | S. 15° W.     |
| Cross lake, near south-west end.....                    | S. 56° W.     |
| " south-west corner of Indian Reserve.....              | S. 54° W.     |
| " island north of Indian Reserve.....                   | S. 53° W.     |
| " 7 miles north-east of the H. B. Post.....             | S. 65° W.     |
| " 10 " " ".....                                         | S. 65° W.     |
| " near north-eastern end.....                           | S. 63° W.     |
| Nelson river, above Duck lake.....                      | S. 61° W.     |
| " entrance to Duck lake.....                            | S. 66° W.     |
| Sipiwek lake, south-western end.....                    | S. 60° W.     |
| " Old Fort point.....                                   | S. 65° W.     |
| " Cross portage.....                                    | S. 69° W.     |
| Island in Kiskittogisu lake.....                        | S. 57° W.     |
| " Kiskittogisu river.....                               | S. 60° W.     |
| Kiskittogisu lake, north end.....                       | S. 45°-50° W. |
| " " east shore.....                                     | S. 44° W.     |
| " " south-east shore (second).....                      | S. 45° W.     |
| " " " (first).....                                      | S. 65° W.     |
| " " south-west side (second).....                       | S. 66° W.     |
| " " " (first).....                                      | S. 41° W.     |
| Minago river, 5 miles below the Painted Moose.....      | S. 50° W.     |
| " " 2½ " ".....                                         | S. 46° W.     |
| " " north end of Hill lake.....                         | S. 45° W.     |
| Water-lily lake.....                                    | S. 55° W.     |
| Muhigan river, near Duck lake portage.....              | S. 68° W.     |
| Landing lake, 4 miles from Cross portage.....           | S. 80° W.     |
| " " 6 " west end.....                                   | W.            |
| " " 3 " ".....                                          | S. 85° W.     |
| Wintering lake, 1 mile north of Old Post.....           | W.            |
| " " granite hill, west shore.....                       | S. 87° W.     |
| Paint lake, south-east end.....                         | N. 75° W.     |
| " " (earlier set).....                                  | S. 42° W.     |
| Lake east of Ospwagan lake.....                         | N. 80° W.     |
| Pipe lake, south end of northern half.....              | N. 82° W.     |
| " south point on west shore.....                        | N. 87° W.     |
| " " " (earlier set).....                                | S. 20° W.     |
| " two miles north on west shore.....                    | N. 89° W.     |
| " near north end.....                                   | N. 84° W.     |
| Burntwood river, above Manasan falls.....               | S. 88° W.     |
| " 2 miles above Manasan falls.....                      | S. 86° W.     |
| " Kepuche falls.....                                    | N. 77° W.     |
| " island in Opegano lake.....                           | N. 87° W.     |
| " Taskinigup portage.....                               | N. 72° W.     |

|                                                  |               |
|--------------------------------------------------|---------------|
| Burntwood river, Taskinigup (earlier set).       | S. 43° W.     |
| " Wuskwatin portage.                             | N. 83° W.     |
| " " (earlier set).                               | S. 37° W.     |
| " Wuskwatin lake.                                | N. 78° W.     |
| " " (earlier set)                                | S. 37° W.     |
| " 10 miles above Wuskwatin lake.                 | S. 38° W.     |
| " 11½ " "                                        | S. 37° W.     |
| " Limestone Point lake.                          | S. 20° W.     |
| Footprint lake } near north-west end.            | S. 16° W.     |
| " Nelson House.                                  | S. 14° W.     |
| Grass river, 12 miles above Paint lake.          | S. 26° W.     |
| " " " (earlier set).                             | W.            |
| " " 2½ miles below Pisew falls.                  | S. 41° W.     |
| " " Pisew falls.                                 | S. 8° W.      |
| Setting lake, 4 miles from north end.            | S. 87° W.     |
| " 5 " "                                          | S. 70° W.     |
| " 3 " mouth of Grass river.                      | S. 70° W.     |
| " 3 " " (earlier set).                           | S. 80° W.     |
| Pakwahigan lake, north end.                      | S. 44° W.     |
| Grass river, Wapichtigow falls.                  | S. 85° W.     |
| " " " (earlier set).                             | S. 86° W.     |
| " " Sasago rapid.                                | S. 42° W.     |
| Wekusko lake, north end.                         | S. 40° W.     |
| " " island near north end.                       | S. 20-23° W.  |
| " " mouth of Notaminihewi creek.                 | S. 30° W.     |
| Reed lake, island off point on east shore.       | S. 15° W.     |
| " island in south-east bay.                      | S. 36° W.     |
| Cranberry lakes, north division.                 | S. 36° W.     |
| Athapuskow lake.                                 | S. 28° W.     |
| Goose lake, north end.                           | S. 37° W.     |
| Namew lake, south-east shore.                    | S. 33° W.     |
| Namew river, Rat Portage.                        | S. 17° W.     |
| Beaver lake, island in.                          | S. 24° W.     |
| Sturgeon-weir river, 15 miles above Beaver lake. | S. 17° W.     |
| " Leaf portage.                                  | S. 7° W.      |
| " Birch portage.                                 | S. 7° W.      |
| " Dog portage.                                   | S. 12° 27' W. |
| " Pot-hole portage.                              | S. 12° 27' W. |
| Outlet of Wabishtock lake, Pine-root river.      | S. 18° W.     |
| Beaver fall, Kibissing river.                    | S. 39° W.     |
| Churchill river, below Pukkatawagan fall.        | S. 45° W.     |
| " Loon fall.                                     | S. 40° W.     |

## SILURIAN.

Undisturbed horizontal limestone, of about the age of the Niagara formation of New York and Eastern Canada, was seen at several low outcrops on the south shore of Pine Island lake. On page 36 a list of fossils is given, collected from a point of this limestone seven miles east of Cumberland House.

## CAMBRO-SILURIAN.

Undisturbed flat-lying limestone, similar to the Galena limestone of <sup>Cambro-Silurian</sup> Lake Winnipeg, underlies the southern portion of the region as far <sup>limestone.</sup> north as Grass river. Towards the north it terminates in a steep escarpment from fifty to one hundred feet in height. This escarpment runs north-westward from the north end of Lake Winnipeg, crosses Minago river at the head of Hill lake, probably passes the south end of Setting lake, though this was not determined, and reaches Grass river at the south end of Wekusko lake. Then it turns westward forming a steep wooded hill or abrupt rocky cliff along the south side of Reed lake. It strikes the east side of the middle sub-division of Cranberry lakes and then turns southward, forming a deep rounded bay in which lie Goose and Athapuskow lakes.

The examination of the rock was confined to places on the face of the escarpment convenient to the lakes and rivers traversed, and to some points on the shore of Namew lake. The limestone is for the most part thick-bedded and of a yellowish gray colour, but some of the lower beds, south of Wekusko lake, have a distinctly reddish colour, which, however, is sometimes rather blotchy. The limestone is underlain by from ten to twenty feet or more of soft and rather coarse sandstone, deposited in shallow water in the gradually sinking floor of the Trenton sea.

In one place where the sandstone was well shown, one band was fairly rich in fossils, but the rock was so friable that it was very difficult to get them out, or to save them after they had been obtained. The limestone was remarkably poor in fossils, and in many places none at all could be found in the time at our disposal. The following is a list of the recognizable forms obtained:—

- Receptaculites Oweni.*
- Crinoid stems.
- Columnaria alveolata.*
- Columnaria (Palaeophyllum) rugosa.*
- Streptelasma robustum.*
- Calapæcia Canadensis.*
- Stictopora acuta.*
- Orthis testudinaria.*
- Leptæna unicoslata.*
- Plectambonites sericea.*
- Dinobolus parvus?*



*Cyrtodonta*, sp.  
*Maclurei Manitobensis*.  
*Liospira*, sp.  
*Murchisonia* or *Loxonema*, sp.  
*Trochonema* or *Pleurotomaria*, sp.  
*Orthoceras*, sp.  
*Endoceras subannulatum*?  
*Tripteroceas Lambii*.  
*Gyroceas submamillatum*?  
*Bumastes Trentonensis*.  
*Cheirurus pleurecanthemus*.

In the underlying sandstone the following species were found:—

*Ctenodonta subnasuta*?  
*Pleurotomaria*, sp.  
*Murchisonia* or *Loxonema*, large sp.  
*Helicotoma*, sp.  
*Bucania Buellii*?  
*Bellerophon*, sp.  
*Orthoceras semiplanatum* or *planoconvexum*.  
*Endoceras (Nartheoceras) crassisiphonatum*.

#### HURONIAN.

Huronian  
areas.

The existence of the following areas of Huronian rocks was determined, viz: at Cross lake, Pipe lake, and the large area extending from Wekusko to Athapapuskow lake. The first is separated from the others, but further exploration may show that the last two are connected.

Muscovite  
of probable  
economic  
value.

The Cross lake area consists of two bands of micaceous schist or schistose conglomerate, one striking westward across Pipestone lake and the other south-westward along Cross lake, the two joining towards the north-west end of Cross lake. In places this schist is altered into a rusty gneiss very similar to the rusty Sillimanite gneiss of the Grenville series, but whether it has precisely the same composition has not yet been determined. The schist is in more or less vertical attitude, apparently squeezed between the Laurentian gneiss on each side. It is cut by many irregular veins of white quartz and in some places is highly charged with mispickel. Towards the south-west it is cut by wide veins and bands of coarse white pegmatitic granite containing large crystals of tourmaline and muscovite.

Crystals of the latter could probably be obtained of sufficient size to be of economic value.

The schist is also cut by dykes of dark-gray gabbro, and in the contact zone between the two rocks there is often a considerable quantity of iron- and copper-pyrites. On the south side of the southern band of schist is a mass of coarsely crystalline light greenish-grey anorthosite, consisting almost entirely of plagioclase. The Pipe lake area consists of a band of fine-grained green schist, striking north-east and south-west, and lying in a trough in the surrounding gneiss.

The Cross river area is very much more complex in its character, and as it was not discovered until rather late in the autumn it was impossible in the remaining few days of the season to do more than obtain a rough idea of its structure and of the nature of some of its more typical rocks, the details of which will be found in the descriptions of the localities. A thinly foliated staurolite schist, doubtless an altered clastic rock, strikes down the northern arm of Wekusko lake, and down the river for a short distance below it. Further south on Wekusko lake the staurolite-schist is represented by a fine-grained green chloritic schist. Further down the river is another newer band of staurolite schist, and east of that is a ridge of light-green diabase. On the east side of Wekusko lake the schist is in contact with reddish gneiss and light-gray massive granite, while on the west side of the northern portion of the lake it is in eruptive contact with a coarse massive gabbro, which extends southwards as far as Wekusko point. Further north a diorite underlies the rounded peninsula extending into the west side of the lake, north of which is an extensive area of massive, medium-grained red granite, also apparently erupted through the schist. Above the lake the river runs along the contact of the red granite, and the clastic rocks, which have here the form of a highly altered green schistose conglomerate. At one point is a boss of massive red quartz-porphyry, very similar to the quartz-porphyry of the Keewenawan rocks of Lake Superior. Above this is an area of coarse dark-green gabbro, and then a reddish massive granite-gabbro extends up to Reed lake. For the rest of the distance up to Cranberry lakes and over to Athapapuskow lake, the prevailing rocks are chloritic or sericitic schists, altered from diabases or clastic slates, cut by massive diorites and gabbro. Along the lines of contact with these rocks and with the surrounding gneiss, quartz veins occur, usually highly charged with pyrites.

Rocks on  
Wekusko  
lake.

## LAURENTIAN.

Laurentian  
type of rocks

Granites and granitoid gneisses of Laurentian type underlie the greater portion of the country here reported on. As a rule, they seem to have the same general strike as the adjoining Huronian rocks, giving the two formations the appearance of having been disturbed, altered and reduced to their present condition at the same time.

## KISKITTOGISU RIVER.

Kiskittogisu river was reached by a portage two miles and a half long, from the west side of Playgreen lake. The portage has a general direction a little north of west. For about half of its length it crosses a sandy plain, after which it passes through a wet tamarac swamp. At the portage the river is a hundred yards wide and without current, with a wide marsh stretching out on each side. The water is dark-brown in colour. The river maintains this character for six miles until it reaches the south side of Kiskittogisu lake. The south and west shores of this lake were explored for nineteen miles, but its total extent was not determined. The south shore is at first low and marshy, and then to a point nine miles from the river, it has a sandy beach strewn with whitened tree trunks, behind which is a cliff from ten to twenty feet high, composed at the top of six or eight feet of peat, under which is a bed of stratified clay, evidently a northward continuation of the clay and peat deposits at the north end of Lake Winnipeg. At the above distance where the shore begins to bend towards the north-east, boulders begin to make their appearance, and a little island off the shore is composed entirely of well-rounded boulders.

First outcrop

A mile and a quarter further towards the north-east, the underlying Laurentian rock first outcrops on a small island, as a somewhat thinly foliated dark-gray hornblende-gneiss striking N. 35° E. It is interfoliated with bands of rather coarse-grained gray granite. The surface is strongly scored by glacial markings trending S. 58° W.

For the remaining eight and three-quarter miles the shore and the islands lying off it seem to be composed of massive or heavily foliated light-gray medium-grained biotite-granite. Except along the shore, the rock is everywhere covered by a few feet of stratified clay bearing a forest of spruce. The Kisipatchewuck falls are just at the point of discharge of the lake. They have a width of about 80 yards and a

drop of ten feet. Past them is a portage three hundred yards long on the west side over clay. For four miles below the falls the river has a strong current between rocky banks to the point where Kiakitto lake opens into it from the west. The water is white with suspended clay. At its south-west end are cliffs twenty feet high of horizontally and evenly stratified white or light-yellow clay without pebbles or boulders. The first rock outcropping on the north-west shore is a very irregularly foliated light-gray gneiss. Its surface is beautifully smoothed and the north-east sides of the little knolls are well rounded, while the south-west sides are rough and broken. Three sets of striae can be clearly distinguished. The earliest, seen in a few protected spots, trends S. 41° W. The second and most conspicuous, forming most of the coarse grooves on the level surfaces, S. 66° W. The latest, rubbing out the previous one on many of the north-westerly slopes and represented by fine grooves and scratches on the level surface, trending S. 52° W.

Three sets of  
glacial striae.

Three-quarters of a mile further towards the north-east there is a small island of greenish-gray hornblende-gneiss, composed of quartz, orthoclase, plagioclase, hornblende of a rather pale green colour, garnets formed after the hornblende and containing it, and some small particles of iron ore. Most of the remainder of the north shore seems to be composed of moderately dark-gray well foliated biotite gneiss, striking about N. 55° E., and with more or less vertical dip. A large dyke of dark-green coarse-grained diabase, about sixty yards wide, extends in a direction S. 45° W., down through the north-east side of the lake and outcrops on a number of islands.

On one of the adjoining islands, where the gneiss is overlain by two or three feet of light-yellow stratified clay without pebbles, the bedding is a good deal disturbed. On the south side of the same island a scarped bank shows two feet of unstratified till with pebbles and boulders overlying the stratified clay. The matrix of the till is clearly the same as the stratified clay, but it has been kneaded together and mixed with some foreign material. It was probably formed by a slight re-advance of the Labradorian glacier from the east, after the clay had been deposited in the water in front of it. For seven miles below this lake the banks of the river are composed of red and gray gneiss, with occasional narrow bands of darker hornblende or mica schist. The gneiss and schist are overlain by stratified clay which extends on both sides as a plain from ten to twenty feet above the river. Towards the end of the above distance a few boulders are scattered along the banks. As the Nelson river is approached the

Readvance of  
Labradorian  
glacier.

Lake Agassiz clays are left behind, and the country becomes bare and rocky and the surface of the rock is rough and weathered, not smooth and polished like that which has been protected by the impervious stratified clays. The rock at the mouth of Kiskittogish river, not far from the upper end of Whisky Jack portage, is a light-gray gneiss including many strings and broken bands of rounded or angular fragments of dark-gray gneiss or altered diorite. The foliation runs N. 60° E., but is wavy, and flows around the darker inclusions. A better example of flow structure in the gneiss on a large scale is seldom seen.

### MINAGO RIVER.

Section on  
Minago river.

Minago river rises on the limestone plateau near the north shore of Moose lake, and flowing in an east-north-easterly direction, empties into the west end of Cross lake. At the south end of Hill lake in approximately north latitude 54° 15' it leaves the limestone. In a cliff fifty feet high the following descending section is here seen:—

|                                                                                                                             | Feet. |
|-----------------------------------------------------------------------------------------------------------------------------|-------|
| Fine light-gray horizontally stratified Agassiz clay without pebbles or boulders . . . . .                                  | 25    |
| Light-yellow thick-bedded Trenton limestone with rather fine porous texture and breaking readily in any direction . . . . . | 17    |

Fossils were very scarce but the following were found:

*Columnaria alveolata.*

*Streptelasma robustum.*

*Endoceras subannulatum?*

|                                                                                           | Feet. |
|-------------------------------------------------------------------------------------------|-------|
| Light-gray, brownish-weathering sandstone, thick-bedded, and rather fine-grained. . . . . | 10    |

Fossils.

A foot below the top there is a fossiliferous band but the fossils were very difficult to extract. However, the following were obtained and are sufficient to determine the rock as being clearly of Trenton age:

*Ctenodonta subnasuta.*

*Pleurotomaria*, sp.

*Murchisonia* or *Loxonema*, large sp.

*Helicotoma*, sp.

*Bucania Buelli?*

*Orthoceras* either *sempianatum* or *planoconvexum*.

*Endoceras* (*Narthecoceras*) *crassiphonatum*.

Under the clay the surface of the limestone is smoothed and strongly marked by glacial grooves as is shown on large masses fallen down the cliff. Eight miles northeast from the cliff of Trenton limestone low outcrops of gray Laurentian gneiss begin to appear at the water's edge, cut by one or more dykes of dark-green diabase. The river below Hill lake is thirty-three miles long and at only one place near its mouth is there any current. Drunken lake is an expansion of the river twenty miles below Hill lake, and between the two lakes the banks are at first marshy and then rise to a clay plain three or four feet above the water. Here and there are low glaciated knolls of gray gneiss, striking more or less parallel with the river banks. The shores of Drunken lake are generally low and moderately well wooded, with rocky knolls here and there on the south side.

Below Drunken lake the banks are much more rocky, with little or no covering of clay. The rock is generally a dark-gray hornblende gneiss, cut in two places by dykes of dark-green amphibolite. Eight miles below Drunken lake the gneiss is cut by the Cross Lake white granite, and thence to the mouth of the river this granite forms a conspicuous feature along the banks. Near the mouth an esker twenty-five feet high composed of fine sand without pebbles or boulders rises close to the west bank. Esker near mouth of river.

Seven miles below Hill lake a small brook flows into the river from the west, and half a mile up this brook is the beginning of a portage path, which the Indians occasionally make use of to reach Wolf river. The portage is three miles and three-quarters long, and for most of the distance is through a mossy swamp, or over a reedy marsh supporting a few small scattered tamarac trees. Several low bosses of gray gneiss run through the swamp, and about the middle of the portage for half a mile is a dry clay plain, wooded with spruce and Banksian pine. At its north-west end the portage reaches the shore of Waskik lake.

#### MICHIGAN RIVER.

A quarter of a mile S. 80° W. from the end of the portage is a point of gray gneiss striking N. 35° E. 50° E. The east shore of Waskik lake is generally swampy, while the west shore is broken by low rounded rocky points. Near the north-west angle of the lake there is a medium-grained irregularly foliated gray gneiss, cut by heavy veins of coarse red pegmatite and one or more narrow dykes of diabase. The shore and islands are covered with from three to six feet of soft Agassiz clay. From the north-west angle of this lake a marshy creek Michigan river.

a quarter of a mile long runs to another similar lake about a mile and a half long, from the north-east end of which the river winds through a marsh between tamarac swamp for three miles and a half to the south end of a third lake, very similar in character to the other two, with low, thickly wooded shores and rocky points of light-grey gneiss.

The river flows from the north-east side of this third little weedy lake and has marshy banks for three miles to a rapid with a descent of eight feet, past which is a portage 140 yards long on the east side over a hill of clay. For the next three-quarters of a mile the stream is fifty feet wide and well defined between clay banks ten feet high, from which little rills are washing out bars of sand. Then there is a fall of ten feet, opposite which the stratified clay rises thirty feet above the river to the top of a knoll of gneiss and whitish pegmatite.

Country  
burnt over.

For the next six miles the river is thirty to forty feet wide, with a moderate current and continues N. 15° E., in the bottom of a narrow valley thirty-five feet deep, from the sides of which many trees had fallen and had to be cut away before our canoes could pass. On the top of the bank is an extensive undulating clay plain. This country has all been burnt over and much of it is now almost treeless, like partly open prairie, with scattered grooves of small poplars and alders. Strawberries were growing on the ground in great profusion. At the end of this six mile stretch the river turns sharply eastward, and within a mile and a half is obstructed by four rapids, the Muhigan rapids, with descents respectively of two, four, six and fifty feet. Above the upper rapid the river bank, twenty feet high, is composed of fine brown sand. At the lower rapid the water rushes through a narrow gorge along the strike of the gneiss, at first dropping as a mass of fleecy spray and foam over the jagged rocks, and then hurrying along between steep rocky walls.

At the foot of the gorge on the south bank a huge sub-angular mass of gneiss is perched on the side of the hill, rising much higher than the top of the hill, and is supported in its present position by smaller masses of rock. This great perched block is known as "The Wolf stand" and from it the river is also called Wolf river. The country here seems to descend from sixty to eighty feet, and the river winds through an extensive willow-covered flat, apparently encircled by hills, those to the south being rocky and bare. For fifteen miles the river winds through this country. The banks are low and reedy. Behind the reeds there is a belt of willows and behind the willows are the sloping banks of the valley rising to a white silt plain wooded with Banksian pine, or to the low ridges of gneiss wooded with spruce and poplar. In this vicinity

large game was very plentiful, eleven moose having been seen by the writer in one day. For two miles above the junction of the west branch the valley is narrow and about fifty feet deep with steep sloping sides of light-gray clay, rising to a clay plain. The river was very much obstructed by fallen timber. Large game plentiful.

At the Forks the banks become lower and the river is wider and less rapid. For three miles and a half it flows between clay banks from fifteen to twenty feet in height, the easy current being broken by three short rapids. There it opens into a small lake a mile and a quarter long, the banks of which are overlain to a height of twenty-five feet, with light-gray stratified clay. From this lake Muhigan river is said to continue northward and to empty into Nelson river, near Sipiwesk lake. But the canoe route commonly used by the Indians leaves the east side of the lake, and ascending a little brook for half a mile, reaches the end of a portage. This portage is a mile and a third in length, and crosses a wooded clay ridge a hundred feet high, to the west side of Duck lake, one of the expansions of Nelson river.

#### NELSON RIVER.\*

The Nelson river in its northerly course of 230 miles, from Lake Winnipeg to Split lake flows in one or more rather shallow and often ill-defined channels for the most part through a country underlain by Laurentian granite and gneiss. At Pipestone and Cross lakes it passes over an area of hornblende and mica-schists and highly altered conglomerates.

Playgreen lake into which the river expands shortly after it leaves Lake Winnipeg, lies along the south-western edge of the Archaean nucleus. While its south-western shore is for the most part composed of clay and peat, its north-eastern shore consists of low rounded bosses of granite or more or less distinctly foliated gneiss. At one point a scarped bank of sand and pebbles, thirty-five feet high, rises from the edge of the water to a narrow sandy plain, probably an esker, extending into the country to the north-east.

From Playgreen lake the river flows by several streams, the more easterly of which pass through Little Playgreen lake on their

A survey of the whole course of this great river from Lake Winnipeg to Hudson bay was made by Dr. R. Bell in 1878 and 1879 and a description of its topography, geology, etc., is contained in the reports of progress of the Geological Survey of Canada for those years. A map accompanies the report of 1878.



Pegmatite  
veins holding  
minerals.

way to Cross lake. Little Playgreen lake lies entirely within the country underlain by Archaean rocks. The banks are rocky, with marshy bays on the east side and long sandy beaches in front of thick woods on the west side. The rock is still a rather irregularly foliated gray gneiss, associated with which, near the south end of the lake, is a rather coarse-grained massive diorite. Near the north end of the lake is a light reddish-gray massive biotite-granite cut by veins, a foot or more in width, of red pegmatite containing crystalline masses of molybdenite, with occasional crystals of pyrite and magnetite. In the bank of the river, seven miles below Little Playgreen lake, opposite the mouth of Pine creek, is a dark-gray rather fine-grained diorite or uralitic diabase, probably forming part of a large dyke cutting the gneiss. A few transported boulders are scattered along the banks in this vicinity, but they become rare as the river is descended.

Inclusions in  
gneiss.

A mile below Sea-river falls, on the north-west side of a rather wide stretch of quiet water, is an esker or ridge of sand forty feet high. It runs steeply from the water and as far as one can see into the rather scattered forest of Banksian pine; its summit is a plain of sand and gravel. It runs about S. 50° W., and the Indians assert that it is continuous with the sand ridge on the south-east side of Playgreen lake. In the opposite direction it can be readily recognized on the east side of the Nelson river as far north as the Etoimami river. Below this the banks are of gneiss, usually covered with a few feet of clay to within a short distance of Pipestone lake. At the lowest portage the gneiss is cut by a dyke striking S. 10° E. of fine-grained dark-green diabase, consisting of plagioclase in numerous interlocking lath-shaped crystals, the intervals between which are largely filled with biotite, some of the crystals of which have been altered around the edge to hornblende. A little biotite is present, and ilmenite surrounded by leucoxene. As Pipestone lake is approached the gneiss contains many dark, often angular, inclusions around which the foliation flows. In places the inclusions are so numerous and distinct as to give the gneiss the appearance of a conglomerate.

About three-quarters of a mile from Pipestone lake the bank is composed of a massive greenish-gray anorthosite, containing small irregular patches of biotite and grains of copper-pyrites. In places it is coarsely crystalline, a fresh fracture showing large cleavage surfaces of plagioclase, while in other places it is finer-grained and breaks with an irregular greasy fracture. At the principal outcrop visited it is in contact with a dark-gray finely crushed diabase in which the

pyroxene is altered to hornblende which sends off a narrow dyke into the anorthosite. The diabase is cut by a vein of pegmatitic granite.

The anorthosite is here a comparatively narrow band, and just north of it is a thinly foliated green garnetiferous chloritic schist composed of biotite largely altered to chlorite, quartz very much shattered, small rounded garnets, arsenopyrite, epidote and zoisite. It strikes S. 57° E. and has an almost vertical dip. The south shore of Pipestone lake, west of the mouth of the river is composed of similar chloritic schist, in places varying to a conglomerate and holding well rounded pebbles of gneiss.

An island out in the lake two miles and a quarter from the mouth of the river is crossed by a dyke of squeezed diabase in which the augite is almost entirely altered to a light-green hornblende, and contains numerous flakes of biotite, consisting of thinly foliated light-green chloritic schist. The diabase contains also a large quantity of copper and arsenical-pyrites. Just to the west of this island is a chain of islands extending N. 25° E. composed of a dyke of massive coarse or medium-grained sausalite gabbro which becomes finer-grained as it reaches the north shore of the lake. On the shore no rock was seen close to the dyke, but a few yards distant there are low cliffs of dark green chloritic schist very much crumpled and altered. This gradually changes into a soft sericitic schist, which is cut by wide veins of white milky quartz.

Copper and  
arsenical  
pyrites in  
diabase dyke.

The beach along the north side of the lake is strewn with boulders. On an island in the river, half a mile below the lake, the surface is strongly marked by glacial grooves trending S. 50° W. while in a protected spot a few earlier grooves were found trending S. 15° W. The clay overlying the chlorite schist in the middle of the island is a fine white incoherent silt, without boulders.

On the point of an island two miles and a half below the lake the rock is a conglomerate filled with rounded pebbles of white quartz, etc., and darker and more angular pebbles of schist or diorite. The bedding is very irregularly broken, but seems to strike north. Hard in line with the bands of pebbles, while the schistosity strikes S. 75° E. with nearly vertical dip. At the point of entrance with Cross lake the rock is a dark greenish-gray schistose conglomerate with pebbles similar to those last mentioned, most of which are rounded or oval, as seen on the surface, while they are often greatly elongated vertically. The matrix is a thinly foliated garnetiferous biotite schist, striking S. 55° E. and with vertical dip. On the beach are lying some large masses of light-green sericitic schist, the pipestone of the Indians.

Large crystals  
of muscovite.

Cross lake lies along a band of chloritic schists, schistose conglomerate and fine-grained gneisses, and the islands and the more prominent points are for the most part composed of these rocks, while the surrounding country is composed of gray, more or less distinctly foliated Laurentian gneiss. On the south shore dark-green garnetiferous hornblende schist, continuing across from Pipestone lake, was seen almost in contact with the gneiss, and the two rocks have the same dip and strike. On the south side of the Indian Reserve island this hornblende-schist was cut by large dykes or masses of very coarse white pegmatite granite containing large crystals of tourmaline, biotite and muscovite. Some of the latter were as much as nine inches and a half in length, and some smaller ones which were extracted were of excellent quality. This white pegmatite, which we may call the Cross lake granite, extends south-westward to the end of the lake and for several miles up Minago river, forming low but conspicuous rounded white hills.

On the south-east shore of the Indian Reserve island, the rock is a fine-grained green schist or squeezed greywacke, weathering into indistinct oval masses and with a general strike about N. 55° E., while Otter island between it and the east shore is a thinly foliated green porphyritic schist. Gray Laurentian gneiss was found on the south-east side of the Indian Reserve island, and the east shore opposite is also composed of similar gneiss. East-north-east from the Indian Reserve lake lies in a trough excavated along a band of dark hornblende and micaceous schists and rusty gneisses, with more or less vertical dip and often highly charged with arsenical pyrites. A thin section of rock from an island north of the Indian Reserve consists of hornblende in large amount, quartz very much crushed and shattered, orthoclase, plagioclase, a few scales of biotite, calcite in large quantity, apparently primary, and many small patches of ilmenite altering to leucoxene. Another specimen collected near the north-eastern end of the lake was found to have almost precisely similar character. In the northern part of this portion of the lake some of the islands, probably along the line of a dyke, were composed of a coarse or medium-grained gabbro often with indistinct diabase structure.

Post-glacial  
deposits.

Towards the north-eastern end of the lake the surface of the rock is quite free from any covering of stratified sand, clay or silt, but as the Nelson river is approached these post-glacial stratified deposits begin to make their appearance, and they gradually become heavier towards the south-west, where they have an average thickness of ten feet or more. The Indian Reserve island and the adjoining smaller islands are covered with a light rather friable stratified clay, which

makes an excellent soil for the growth of all the vegetables and garden produce common in Manitoba. The eastern limit of these stratified deposits marks the line of the greatest easterly extensions of Lake Agassiz as shown on a preceding page.

Nelson river flows from Cross lake by several channels and the one we followed was that commonly used by the inland freighting boats of the fur traders descending the river. The banks are exceedingly monotonous, being everywhere composed of red and gray gneiss more or less regularly foliated, occasionally cut by dykes of diabase or gabbro. This rock is covered by from five to twenty feet of soft gray clay. Pebbles and boulders are conspicuously rare except in the straight narrow reach below White Mud falls. Here the gneiss strikes along the river and dips at a low angle ( $15^{\circ}$ - $25^{\circ}$ ) north-eastward. On this account the rocky bank on the north-west side rises in an easy slope and as the glaciation was from the north-east the surface has been smoothed and well rounded. The north-east bank having broken across the lamination of the rock and also having been protected from glacial abrasion, is particularly ragged and abrupt. On this bank in the hollows between the cliffs of gneiss, and underlying the stratified Lake Agassiz clays, are banks up to forty feet in height, of a mixture of sand, pebbles and well rounded boulders. The material is very loose and it had evidently been deposited in rapid water. This coarse gravel is of early glacial age and is the remains of a bed of gravel that has filled this portion of the valley from side to side. This bed of gravel may have been laid down in the valley near the face of the Keewatin glacier, as that glacier was advancing southward, and the fragments of the bed that still remain are in such positions that they would have been protected from the Keewatin glacier from the north and the Labradorian glacier from the west. As the Labradorian glacier retired these fragments were buried under the clay deposited in the bottom of Lake Agassiz.

Banks of  
glacial gravel.

At Masuto falls, a mile and a half below where the two branches of the river diverge, the west branch is crossed by a dyke between two hundred and three hundred feet wide, striking S. 33° W. of a rather coarse dark-gray diabase, composed of plagioclase in stout lath-shaped crystals, augite, hornblende around the edges of some of the crystals of augite, and a considerable amount of iron ore. The surrounding rock is a rather fine-grained and lightly foliated granite gneiss. Near the foot of the rapid is a cliff of coarse-grained light-gray norite or gabbro.

Imperfect  
drainage of  
Nelson river.

At the point of discharge of the river into Duck lake is an outcrop of dark-gray hornblende-schist cut by heavy veins of white pegmatite. The imperfect character of the drainage of the Nelson river is very clearly shown at Over-the-hill rapid, where the great river falls several feet over hard Laurentian rock, while a short distance to the west there is a narrow neck of soft gray clay a hundred yards in width, without any sign of the underlying rock, between the quiet water above and that below the fall. When this neck of clay is cut through or is worn down by atmospheric agencies the fall will disappear.

A heavy diabase dyke crosses the river a mile below this rapid, and three-quarters of a mile lower is a rapid caused by a band of dark-gray hornblende schist crossing the river. The schist is highly garnetiferous and in places is porphyritic from the presence of elongated masses of quartz. It is cut by many narrow stringers of white opaque quartz. The strike of the schist is S. 50° W. 75° N.W. The banks of the river for a mile and a half continue to be formed of this garnetiferous hornblende schist, which is often cut and broken by dykes and masses of red and gray granite. Below this the country is again underlain by gray gneiss.

A mile and a half below Red Rock falls is a small island, the east side of which is cut by a dyke of a medium-grained olivene norite composed of plagioclase, monoclinic pyroxene, strongly pleochroic orthorhombic pyroxene, probably hypersthene, hornblende, around the edge of the crystals of monoclinic pyroxene and serpentine, apparently altered from olivene running N. 25° E. towards a point on the east shore. This point is overlain by a fine white silt, rising to a moderately level plain from thirty to forty feet above the river.

Dyke of  
olivene norite.

At Chain-of-rocks rapids a dyke of dark-green medium-grained olivene norite very similar to the above except that the orthorhombic pyroxene is not so highly pleochroic and some of the olivene is rather fresh, perhaps a continuation of the last mentioned dyke, crosses the river. It is horizontally and vertically jointed into squarish blocks, giving it the appearance of a heavy broken wall or dam of rude masonry.

A mile and a quarter below this rapid, on the south-east side of the river, is a cliff seventy-five feet high, of moderately coarse light-brown stratified sand, mixed with a very few pebbles, overlain by three feet of thinly stratified clay. The surface rises slightly for a short distance as it recedes from the bank, and extends for several miles in a north-easterly direction as a broad kame or eskar.

Four miles further north and near the upper end of Sipiwesk lake is Mittonagesik hill, a ridge 150 feet high, extending N. 35° W. and S. 35° E. Its sides are rounded and covered with small poplars, while its summit rises in three more or less conspicuous knobs. The most southerly of these knobs was ascended and was found to consist of transported boulders embedded in a matrix of sand. This ridge is one of the moraines of the Laurentide glacier, and it would seem to have been formed before Lake Agassiz had entirely disappeared, for its lower portion has been to a certain extent worn and modified by the water of this lake.

Moraine of  
Laurentide  
glacier.

Boulders, which have not been at all common along the banks of the river to here, now begin to occur in considerable abundance, and at the south-west end of Sipiwesk lake and for at least four miles down both shores of the lake they cover the beach. At a conspicuous point on the north-west shore the bank is composed of a white, well stratified clay in clearly marked horizontal layers from half to three-quarters of an inch thick. The clay itself is quite free from pebbles or boulders, but its surface seems to be scattered over and studded with boulders of gneiss, diabase and Palaeozoic limestone.

At Old Fort point, on the same side of the lake the rocky shore is composed of thinly foliated hornblende gneiss, striking S. 50° E. < 45° N.E., overlain by a little brownish-gray clay without boulders. A third of a mile to the east are two small bare islands of coarse dark-green gabbro, forming part of a dyke running N. 24° E., as at the Chain-of-rock rapids the gabbro is cut by joints into more or less rectangular blocks. The islands are composed of gneiss overlain by a little clay. Boulders are not plentiful, except on the western points. A conspicuous ridge rises behind the north-western shore.

Cross portage is a mile and a half long, through woods of spruce and poplar and over a ridge of clay fifty feet high. Its north end is on a level clay flat on the south side of a small lake tributary to Landing lake, which lies about thirty feet higher than Sipiwesk lake. The shores of Landing lake are of reddish-grey gneiss striking with the long axis of the lake, cut by dykes of coarse dark-green gabbro. Boulders are not at all numerous, but the rock is generally overlain by a few feet of stratified clay. The surrounding country is rather thickly wooded with poplar, birch and spruce.

Near the western end of the lake, Thicket portage leaves its northern shore and crosses to Wintering lake. The portage is a mile and a quarter long, quite dry, and almost entirely through woods of small

poplar. It is over a brownish-gray clay or silt, through which a few low bosses of gneiss scarcely show. At its northern end it has an easy slope of fifty feet to Winifred lake. This slope is underlain by small boulders, but the rest of the portage is quite free from boulders. The crest of the ridge crossed by the portage is sixty feet above Landing lake while Wintering lake lies fifty feet below it.

Site of old fur trading post.

The shores of the latter are chiefly composed of gneiss, cut by at least one dyke of dark-green gabbro extending N. 60° E. A mile above the point between the two rivers is the site of an ancient fur-trading post of the North West Company. A gray line of gneiss runs along the edge of the water, above which is a thick growth of small poplar and underbrush, and in the background is a forest of spruce. The surrounding shores rise gently from the water, and are densely wooded with a close forest of white spruce, growing on the rich clay soil.

Pot-holes.

The south-west shore of the lake is largely composed of a rather high steep ridge of massive red granite either bare or thinly wooded with Banksian pine. Near the northern end of the lake and at the foot of the granite hill which is here sloping towards the east, is a large pot-hole probably formed by a stream from the face of the Keewatin glacier. The pot-hole was  $4\frac{1}{2}$  to  $5\frac{1}{2}$  feet in diameter at its mouth, which was just on a level with the water of the lake, and it was certainly three feet deep, but how much more could not be determined, for it was nearly full of sand and gravel. Half a mile further up the shore, where the granite hill descends into the lake at an angle of about 30°, two large pot-holes were seen at the edge of the water. One of them, five feet deep, has had the side worn out of it by subsequent erosion.

Towards the western end of the lake the granite comes in contact with a dark hornblende gneiss or schist striking along the shore. A narrow sluggish brook enters the west end of the lake in a wide straight marshy valley. The canoe route ascends this brook for a mile and a quarter, and then leaves it and crosses a portage two-thirds of a mile long, half of which is over dry clay through poplar woods, while the other half is chiefly through a mossy swamp. At its northern end it reaches a small lake three-quarters of a mile long and thirty-five feet above Wintering lake.

On the opposite side of this lakelet is another portage a mile and a quarter long. In the first quarter of a mile it rises up a rocky slope seventy-five feet high to a plain of gray clay wooded with small poplars; in the

next half mile it crosses a rich valley the bottom of which is a deep spruce and tamarac swamp, while in the remaining half mile it ascends a gentle rise and crosses a dry plain that has once been wooded with spruce but is now covered with small poplar and alder. On its northern side this plain drops suddenly forty feet to Paint lake. On the brow of the slope is an outcrop of medium-grained gray gneiss striking N. 75° E.

Paint lake is much broken by many points and islands, and its shores for the most part rise in rounded clayey slopes to heights of from fifty to a hundred feet. At the edge of the water the underlying rock is almost everywhere exposed. It consists of medium gray gneiss with fairly distinct foliation and rather persistent strike N. 45° E., cut by larger and smaller veins of coarse white biotite granite. The country appears to maintain the contour of the surface of the underlying gneiss, but it does not present the rugged barren appearance so common to the districts underlain by Laurentian rocks. Not long ago both the hills and valleys have been covered with a forest of spruce, but almost all of this timber has been destroyed by fire, and has been replaced by a thicket of small poplar, through and above which tall whitened tree-trunks rise here and there. A few green islands, isolated and cut off from the risk of fire are now thickly covered with large white spruce, showing what would have been the general state of the country if it had not been ravaged by fire.

Two hundred yards west of Paint lake, across a ridge of clay thirty feet high, is a small lake a mile long, the east shore of which is an even clay-covered ridge, while the west shore is much more rugged, in places showing steep slopes of bare gray gneiss. Near the south end is a steep rounded hill of white granite. From this lake is a portage two thousand yards long over a diffuse clay-covered ridge, overgrown with small poplars, alders, etc. The ground is dry and is covered with grass, vetches, strawberry plants, trailing raspberry vines, raspberry bushes, pembina currant and red cherry bushes. At the highest point of the portage a low knoll of light-gray gneiss peeps up through the turf. From this knoll the surrounding country may be seen to consist of low gently sloping ridges, all wooded with small poplar, or covered with grass and vetches. Here and there, on a few of the steeper hill-sides, the underlying rock shows itself in little patches.

Another small lake, about the same size as the last, lies west of this portage, and from its western end is another portage six hundred and fifty yards long, over a level clay plain to the top of the bank over-



Pipe lake.

looking Pipe lake, which lies eighty feet below. Pipe lake consists of two more or less oval bodies of water connected by a short almost currentless river. The upper and most southerly division is a little basin about five miles long, surrounded by steep and almost bare rocky hills a hundred feet in height. It holds a few small islands of almost bare rock without any covering of clay. The water is clear and transparent, very different from the muddy water of all the surrounding lakes and streams. The rock of the islands and the south-east shore seems to be generally a more or less massive light-gray gneiss, while the north-west shore is composed of thinly foliated fine grained green Huronian schist, striking N. 55° E. < 60° N.

Syncline in Huronian rocks.

The northern expansion of Pipe lake is somewhat larger than the southern, and its shores are composed almost entirely of fine-grained green schist still striking in a north-easterly direction, but apparently dipping inwards from both sides, thus forming a synclinal trough in the middle of the surrounding Laurentian gneiss. The rocky shores are more or less thickly covered with stratified Agassiz clay, and the water is white and opaque from suspended clay.

The schist has been smoothed and scored by the glaciers from the north and from the east, though the striae made by the former have been for the most part obliterated. In one protected spot striae of the Keewatin glacier from the north were observed trending S. 20° W. while striae of the Labradorian glacier were common everywhere, trending N. 82°-89° W. Since leaving Cross portage on Nelson river, the variation of the compass had been very irregular, so that it was for the most part impossible to make a survey with the ordinary magnetic compass, and it was necessary to use a solar compass in order to obtain the direction of the course travelled.

Manasan river flows from the north end of Pipe lake, and after a course of seven miles and three-quarters, empties into Burntwood river. It winds gently between clay banks from ten to thirty feet in height, and the underlying rock is but seldom exposed. Where seen, it was a grey gneiss occasionally garnetiferous, and with a general north-easterly strike.

*Lower part of Burntwood river.*

Burntwood river.

Burntwood river was ascended from Manasan river to the mouth of Footprint river, a distance of about fifty-five miles. At Manasan falls, just above the mouth of Manasan river the water tumbles about twenty feet in a fine cataract over a band of thinly foliated, dark-gray

hornblende gneiss, striking N. 38° E. and with vertical dip. About two miles above these falls the river opens out into Birch lake, which is merely a long and rather wide currentless part of the river. The underlying gneiss is exposed at some of the points close to the edge of the water, but the banks are otherwise composed of stratified white or light-gray clay or silt, more porous and less adhesive than the clay of Manitoba, and are generally about thirty feet in height. The surrounding country has all been burnt over and now there is very little timber standing on it, the undulating surface being grassy or thinly covered with small poplar scrub. In places, the surface, though now dry, is lumpy as if it had been an old swamp.

Where Birch lake again narrows into the river is a point on the west shore of whitish, medium-grained, very slightly foliated granite, containing a small amount of mica. Three-quarters of a mile higher up is the mouth of Wapichtigow creek, from which there is said to be a long swampy portage to the west shore of Pipe lake. A mile further up the river are Wapichtigow falls, fifteen feet high, where the stream is crossed by a ridge of rather irregularly foliated, dark-gray gneiss, with lighter bands, striking N. 50° E., 60° N.W. Ascending the river for about a mile and a half between steep, wooded banks either of clay or gneiss, Kepuche rapid is reached. Here the water descends three feet in a narrow channel over a ridge of nearly horizontal biotite gneiss, interlaminated with heavy bands of rather coarse, whitish granite.

For the next mile the river has steep, clay-covered banks, sixty feet high, but it and wooded with scrub. Then there is a rapid descent of thirty feet, part of which is a portage, known as Waskatigow portage, four hundred yards long on the east side. At the foot of the portage and protected by a cliff of gneiss is a bank of till, composed of light-brownish clay filled with somewhat rounded and striated pebbles and small boulders. Most of the surrounding country is, however, covered with soft gray stratified clay without pebbles, while on the portage is an exposure of dark-gray, highly garnetiferous gneiss, striking N. 40° E. and dipping eastward at a low angle.

For a couple of miles above this rapid the river flows between steep clay banks which appear to rise to a terrace thirty feet above the water, and then it opens out into Opegano lake which lies between low clay-covered hills and on the west side of which are cliffs of well stratified clay, occasionally overlain by a small thickness of peat. Under the clay is an undulating floor of gray Laurentian gneiss.

Taskinigup  
portage

Above Opegano lake the river flows for nine miles from a W.S.W. direction. The banks usually descend in easy slopes, though here and there bold rocky cliffs overlook the water, and ridges of gneiss cross the channel, forming rapids, past some of which it is necessary to portage. At the heaviest of these rapids the water plunges for fifty feet over a ridge of gray garnetiferous gneiss, striking N. 18° E.  $\angle$  45° S.E. A portage three hundred and twenty yards long and known to the Indians as Taskinigup portage, is here made on the north side of the river. Three-quarters of a mile above Taskinigup, over rather quiet water, are Wuskwatin falls, which have a descent of twenty feet over a ridge of coarse gray garnetiferous gneiss, striking N. 40° E. There is a portage on the north side two hundred and twenty yards long over a hill covered with soft gray clay from the foot of the falls to the shore of Wuskwatin lake, from which the river here issues.

As far up the river as Opegano lake the surface of the gneiss had been generally marked by glacial grooves and striae made by the Labradorian? glacier from the east, and striae of the Keewatin glacier were seen only in protected and favourable spots. Above that lake striae of the Keewatin glacier trending in a S.S.W. direction prevail over the surface of the rock, while striae of the Labradorian? glacier were but seldom seen, for we were now approaching the extreme western limit to which this latter glacier bed was extended, and it would seem that the waters of Lake Agassiz which lay immediately in front of it bore up its attenuated edge. On the shores of Wuskwatin lake the last of these eastern striae were observed, and the extreme extension westward of the Laurentide glacier was but a few miles west of this lake.

Wuskwatin  
lake

Wuskwatin lake is a very pretty sheet of slightly murky water, six or seven miles long and three miles wide, surrounded by sloping clay-covered hills wooded with white spruce and poplar. Its surface is varied by a few islands composed of clay overlying a floor of gneiss. The two falls above mentioned, at and near its outlet, would furnish a large amount of power for driving mills or machinery of any kind, while a supply of timber for building and fuel could be obtained from the surrounding country, and the soil would grow any of the ordinary roots or more hardy cereals, so that it is not improbable that before long when this fertile country is made accessible by the advent of a railroad from the south, one of the most prosperous towns in the district may grow up on the shore of this now secluded lake.

Above Wuskwatin lake the river is wide and sluggish with low banks covered with poplar and willow. Then it turns sharply and flows for seven miles from a little west of north in a valley from sixty to eighty feet deep, through a ridge of well stratified clay that has been deposited on the floor of Lake Agassiz along the face of the Labradorian? glacier. If there had been free drainage from the face of the glacier the position of this ridge would doubtless have been occupied by a terminal moraine of boulders and unassorted till. Looking from the top of the bank on this ridge the country seems to be a great clay plain, cut through by the sloping trough of the river, and trenched by wide lateral gulleys. The surface is generally covered with small poplar, with some spruce in the valleys, and there are no signs of rocky hills, or of rock except here and there at the water's edge. Where the rock appears it is a medium-grained dark gray gneiss often studded with garnets, some of which were found as much as 1.4 inches in diameter.

Country  
clay plain

Above the clay ridge the course of the river again changes, and for five miles it flows from the west between banks eight or ten feet high, covered with scrub poplar and willow. Very little spruce of any value was seen. The character of the country now begins to change, and instead of regular clay-covered slopes and plains, rocky hills rise from one to two hundred feet above the general level, their hard dark sides being but scantily covered with small Banksian pine, while small lakes occupy the deeper depressions.

At a place called the Atwawin, where there are a few Indian houses and a Roman Catholic mission church, the Burntwood river was left and we turned northward into a small stream called Footprint river, which, two miles further up, flows from the south side of Footprint lake. It flows in a valley with steep rocky banks, cutting across the strike of the gneiss. Footprint lake, on the northern shore of which the Hudson's Bay Company have had a trading post for a number of years, and the Methodists have a small church and mission house, has somewhat the shape of a rude cross, seven miles long from east to west, and six miles from north to south. The latitude of the trading post was found to be  $55^{\circ} 48' 26''$  N. The lake is surrounded by banks of light gray friable clay from thirty to forty feet high, through which rise rounded hills of gneiss up to two hundred feet or more in height. The clay extends over the lower portions of these hills, but some of the higher summits appear to rise above it, possibly having risen above the surface of Lake Agassiz where the surrounding clay was deposited on its floor. When the lake was visited in August last both the

Footprint  
lake.

Vegetables  
grown.

trader and the missionary had excellent gardens in which they were successfully growing potatoes, cabbages, cauliflowers, onions, radishes, lettuce, peas, beans, turnips, carrots and other vegetables, and many of the Indians had patches of potatoes sufficiently large to assist materially in the support of their families throughout the winter.

I inquired from the Indians who were living around the lake, how far the fertile clay-covered country extended towards the north, and they told me that it extended as far as Indian lake on Churchill river, north of which the surface is either of sand or rock.

#### CUMBERLAND AND NAMEW LAKES.

Cumberland  
lake.

The shores of Cumberland lake, in the vicinity of Cumberland House, are underlain by horizontal thick-bedded white Silurian limestone in places cherty, and in other places weathering into a rather soft sponge-like or vesicular mass. In places it contains fossils, but unfortunately for the exact determination of the horizon, most of the specimens collected seem to belong to undescribed species. Dr. Whiteaves supplies the following list of a collection made on the north shore seven miles east of Cumberland House:—*Rhynchonella*? sp., *Obolus* or *Dinobolus* sp., Strophomenoid-like brachiopod with sculpture like *Rafinesquina alternata*, *Euomphalus*, n. sp., *Murchisonia* or *Laronema*, sp., *Platystoma* or *Platyceras*, probably undescribed, *Gomphoceras* or *Cyrtoceras*, sp. undescribed, *Orthoceras*, transversely annulated species.

Above the limestone is a covering of light gray calcareous till, filled with boulders, with a thickness of from one to thirty or more feet, and the shores are almost everywhere more or less thickly strewn with boulders.

The point on the north shore, almost opposite that from which the above fossils were collected, is composed of light gray pebbly till, and is surrounded by a large number of boulders. These are chiefly of limestone, white, reddish and yellow and for the most part are well glaciated. There are also a few of green amphibolite, red, gray and green gneiss, dark mica schist, etc. At a point three miles north of Whitways narrows on the east shore of Sturgeon lake, a light gray fine-grained limestone, probably of Trenton age, outcrops near the edge of the water. No fossils were found in place in the rock, but the shore is strewn with large angular masses of yellow porous dolomite, which has doubtless been broken off and shoved up by the ice,

from some bed in the immediate vicinity. It contains such typical Fossils. Galena fossils as *Receptaculites Oweni*, *Maclurea Manitobensis*, *Orthoceras*, with large beaded siphuncle, *Bumastes Trentonensis* and *Chelonicus pleurexanthemus*. Among these names of rock are also a few boulders of soft yellow fossiliferous sandstone, containing, besides some of the species of fossils mentioned above, an apparently undescribed species of *Bellerophon*. The surface of the limestone is well smoothed, and marked by glacial grooves and striae pointing S. 17° W., many of the grooves being crossed by curved transverse fractures opening southward.

On the north shore of Namew lake, at a point four miles west of the mouth of Sturgeon-wet river, the rock is a white or salmon-coloured fine-grained thick-bedded limestone of Trenton age. Dr. Whiteaves has furnished the following list of fossils obtained from it:—*Leptaena*, like *L. unicostata*, *Plectambonites sericea*, *Dinobolus parvus*? *Cyrtodonta* sp., fragments of three species of *Lamellibranchs*, *Liospira* sp., *Murchisonia* or *Loronema* sp., *Trochonema* or *Pleurotomaria* sp., and a *Gyroceras*, which is very much like *G. submamillatum* of the Devonian of the adjoining area to the south.

#### GOOSE AND GRASS RIVERS.

Goose and Grass rivers together form an almost complete water communication between the Saskatchewan and the Nelson rivers, broken only by Cranberry portage, which is rather less than a mile and a half in length, the former discharging into Sturgeon river a short distance above Namew lake and the latter into Nelson river, a short distance above Split lake. Three miles above the mouth of Sturgeon river, Goose river joins it from the east. For two miles and a half this stream is from fifty to sixty yards wide and has sloping clayey banks ten feet high, which rise to a clay plain wooded with poplar and a little spruce. Above this quiet part of the river is a long rapid full of boulders, overlying a bed of limestone, past which is a portage half a mile long on the north-west bank, over level clayey ground through woods of small poplar.

For three miles above the portage the river is a series of shallow rapids over a bed of limestone, and then for another three miles to the south end of Goose lake, it is wide with marshy banks that extend back to low land covered with a forest of poplar.

Goose lake.

Goose lake lies in a bay in the edge of the limestone along the contact of the unaltered Palaeozoic limestone or sandstone with the highly altered Archaean gneisses and schists. The west shore, along which we travelled, is low at the south end, but towards the north it gradually rises until it forms a high steep limestone escarpment overlooking the lake. This escarpment is immediately underlain by gneiss, and from its base long low points of gneiss extend towards the north-east, beyond which are low rocky islands. One of these islands towards the north end of the lake was found to be a fine-grained dark-gray hornblende gneiss striking S. 75° W. and with vertical dip. Its surface is well smoothed and marked by glacial striae pointing S. 35° W. In the stream coming from Athapapuskow lake, at the lower rapid, is a light gray rather fine-grained gneiss striking S. 30° E., 60° N., while the upper ones are over a massive dark-gray rather coarse quartz-mica diorite, consisting of hornblende showing pale interior, suggestive of alteration from augite, biotite, considerably bleached, rather fresh plagioclase and orthoclase, the former being rather more abundant, much epidote derived from the decomposition of the bisilicates, quartz very much broken up and filling many of the irregular spaces between the other minerals. Above the rapids the river has low clay banks wooded to the water's edge, and flows quietly over a bed of sand or boulders.

Athapapuskow lake.

Athapapuskow lake, from which Goose river flows, is an elongated oval body of beautifully clear transparent water, lying in a general north-easterly and south-westerly direction. The shores and islands in the north-eastern portion of the lake consist of green Huronian schists and fine-grained massive gabbro. About five miles south-west of the head of the river this greenstone is overlain by Trenton limestone, which soon forms a low escarpment a short distance back from the beach. The southern end of the lake and most of its north-western shore were not visited. On the south-eastern shore considerable areas are covered with large white spruce. At a low sandy spot overshadowed with tall white spruce trees near the north-east end of Athapapuskow lake, Cranberry portage begins, and from there it runs in a general north-easterly direction for a mile and a third, to the south end of Cranberry lake, crossing the watershed between the streams flowing southward to the Saskatchewan and those flowing northward to the Nelson.

White spruce.

The portage is over an almost level plain of light-gray clay or reddish sand, wooded respectively with small poplar and Banksian pine, beneath which the ground is covered with bearberries (*Arctostaphylos*).

*phyllos Ura-ursi*), blueberries (*Vaccinium*), and cranberries (*Vaccinium Vitis-Idra*). Towards the north end of the portage some boulders are scattered over the surface, and some low bosses of green Huronian schist rise through the overlying clay. The lakes at both ends of the portage have about the same level. East of the portage there seemed to be a shallow dry channel connecting the two lakes.

The Cranberry lakes form an irregular body of water broken by two narrow straits and indented by deep bays. At the southern end the shores are generally low, but they become higher and more rocky towards the north. Almost all the surrounding country has been swept by fire, but many of the islands are still wooded with white spruce of fair size.

At the north end of Cranberry portage there is a low knoll of light-green chloritic schist, rather irregularly foliated, but generally striking about N. 35° E. The southern and eastern shores south of the first strait are mostly composed of similar green schist, but a mile east of the portage is a low cliff of reddish nodular Trenton sandstone, overlain by nodular Trenton limestone, while a mile and a quarter further east low cliffs of similar limestone skirt the edge of the water. At the first narrows a rounded hill, probably of green schist, runs on the west side, while opposite it on the east side, is a rather high bluff of horizontally stratified limestone. For the next two miles the south eastern shore is underlain by green chlorite and silvery sericitic schists, and then these schists are overlain by light-gray horizontally stratified Trenton limestone rising into high bare rocky cliffs.

The remaining portion of the eastern shore up to the second strait, is composed of a massive medium-grained reddish intrusive granite, while the islands are composed of schist. Near the contact the granite contains angular inclusions of the schist.

At the second strait the rock is a green schist, similar to that seen further south. Just north of the strait a sandy terrace, fifteen feet above the water is a conspicuous feature along the shore. The rocks seen around the most northerly expansion of the lake were all green Huronian schists or slates, very similar to those further south. The level surfaces are strongly marked by glacial striae running S. 28° W.

From the northern end of the lake the river winds through an extensive marsh in the bottom of a wide valley. On the western side of this valley is a rather bare red granite while the eastern side is a ridge of green slaty chloritic schist or greywacke with a general north-and-south strike. Most of the rocky knolls that rise through the marsh



in the bottom of the valley seem to be also composed of this schist, traversed by wide dykes generally parallel with the foliation of the schist, of medium-grained light-gray porphyritic gabbro.

Boulders are scattered rather freely over the southern slopes of some of the hills, but there is little clay except in the bottoms of the valleys.

#### Elbow lake.

Elbow lake is simply a very irregular set of long lanes of water, stretching out between the rocky ridges, where the granite or gneiss closes in on both sides of the green schist. At one high point on the west shore of the lake the green chloritic schist has a strongly marked slaty cleavage striking N. 5° W. At Elbow lake the river turns abruptly southward, and for several miles runs along the east side of the same rocky ridge to the west of which is the valley of that portion of the river just described. Four miles down this portion of the river is a rapid with a descent of fifteen feet, past which is a portage one hundred and sixty yards long on the west bank, over a light-green chloritic and epidotic schist or greywacke, cut by wide veins of white quartz. To the east are rounded hills of greenish, red-weathering hornblende gneiss, with vertical dip, and striking east-and-west, and the river lies in the valley along the line of contact between these two rocks.

#### Schist cut by quartz veins.

At the next rapid, a few hundred yards further down the stream, the schist is cut by a large number of veins of white quartz, most of which are studded with crystals of pyrite. Three-quarters of a mile lower down stream is another rapid with a descent of six feet, behind which is a rocky hill of light-green massive gabbro with well marked concretionary striation. It runs in ridges trending N. 35° E. The surrounding country is now exceedingly rugged and barren, and the rocky hills are either bare or are sparsely covered with stunted poplar or Banksian pine.

Three miles further down the river the bare hills were found to be of a fine-grained squeezed diabase with slaty structure, with vertical dip and striking N. 35° E., cut by many quartz veins. Two miles further is a little rapid between the steep banks of coarse massive diorite. A mile below this rapid the river opens out into a small lake, just below which it strikes against the foot of the limestone escarpment. The escarpment is here sixty feet high, and for the upper twenty-five feet at least is composed of a white or light-yellowish, compact, semi-crystalline limestone in thick horizontal bed. It is doubtless of Trenton age, but I could not find any fossils, except a few

obscure fragments of crinoid stems. The sloping face of the escarpment is densely wooded, and the rock in most places is covered by a deep coating of moss. The surfaces facing the north are all well rounded. Along the coast of the escarpment, and extending back from fifty to one hundred yards, is a low moraine ridge from six to eight feet high of rounded boulders of Archaean rock, chiefly granite and gneiss, derived from the lower area to the north, and had it been a beach it would most undoubtedly have been formed largely of boulders and pebbles from the underlying limestone. It would clearly seem to have been formed when the front of the Keewatin glacier rested against the face of the escarpment. South of the moraine is a level, almost bare surface of limestone, thinly wooded with stunted Banksian pine.

Moraine ridge.

For the next eight miles the river flows eastward, within sight of the limestone escarpment, until it empties into the west end of Reed lake. For four miles of this distance the underlying rock is a light-greenish, rather fine-grained crushed hornblende granite, consisting of quartz, orthoclase, plagioclase, hornblende, altered to chlorite, epidote, zoisite and calcite, with a northerly or north-easterly strike, below which any rock seen was massive green diabase.

Reed lake is a large body of clear water lying along the line of contact of the horizontal Trenton limestones to the south, and the highly altered Archaean rocks to the north. The shores are generally rocky, though here and there are long stretches of sandy beach, while some of the adjoining low land is covered with clay. The surrounding forests are mostly of poplar, but there are some good groves of fine large spruce up to twenty-five inches in diameter. Trout and whitefish are said to abound in the lake. The south shore of the lake and the adjoining islands were also examined, and the rock seen, other than the limestone, consisted chiefly of a fine-grained diabase or a fine-grained chloritic-epidote schist or greywacke. Towards the north-eastern end of the lake these rocks are replaced by a red and green hornblende gneiss, more or less definitely foliated about N. 60° E. A mile down the river below Reed lake is a rapid with a descent of three feet over a point of soft gray clay. The rapid is over a ridge of massive reddish granite.

Reed lake.

This granite extends down the river for nearly half a mile to the next rapid in latitude 54° 38' 30" where it is succeeded by a coarse red and green quartz gabbro, which comes in vertical contact with a massive dark-green gabbro, the line of contact running N. 85° E.

Close to the contact the latter is altered into a chloritic schist, which is cut by veins and irregular masses of white quartz. Four other rapids occur in quick succession, and all are over the dark-green coarse gabbro. Then for three quarters of a mile the river flows between level clay banks, after which the gabbro outcrops for about half a mile as far as a little rapid.

Lake occupies  
valley along  
line of contact.

Below this rapid the stream winds for nearly two miles between low reedy banks, until it falls over a ridge of gray granite into the west side of a long narrow lake. This lake is about fourteen miles long, extending N. 35° E. from the foot of the limestone escarpment. As far as seen it occupies the valley along the line of contact between massive granite and clastic Huronian schists, thus holding a position somewhat similar to the valley of Grass river above and below Elbow lake. East-north-eastward from the rapid at the discharge of the river, on the eastern shore, is a point composed of green slate conglomerate, containing many small irregular pebbles of similar green rock with others well rounded of granite, jasper, etc. The beds strike N. 30° E. 70° E. In irregular contact with the conglomerate is a fine-grained red thinly foliated quartzose rock, the foliation being parallel to that of the conglomerate. However, it runs very irregularly into the conglomerate, sending arms into it and inclosing or almost inclosing masses of it.

Quartz-  
porphyry.

A mile further north-eastward, on the same shore, is a low rounded point of a massive red and green rather coarse quartz-porphyry having a fine-grained microcrystalline groundmass composed chiefly of felspar coloured by particles of iron ore, inclosing rounded grains of quartz, which are much crowded and penetrated by tongues of the matrix, plagioclase in large crystals much decomposed and fractured, the lines of fracture being marked by little strings of epidote, while the surfaces of the crystals are much corroded, small sharply defined crystals of colourless pyroxene, irregular areas or amygdules composed of aggregations of the following minerals: ilmenite altering to leucoxene, chlorite, calcite, zoisite and epidote. A third of a mile further in the same direction is a small island of hard dark-green chloritic schist, or greywacke, while the opposite point on the west shore is of lightly foliated red granite. North-east of this island is the widest and clearest part of the lake. A landing was made at but one place on its eastern shore, and there the rock was a fine-grained light-green agglomerate or slate conglomerate, the pebbles being of very much the same character as the matrix associated with a fine quartz porphyry somewhat similar to that described above, though the phenocrysts are

smaller and composed almost entirely of corroded crystals of quartz and felspar. It also contains a large quantity of mispickel. North-east of this point the east shore was seen to be all composed of this agglomerate, either schistose or massive, while the opposite shore was of massive medium-grained red granite. At its north-eastern end the long lake or wide river expands into an oval sheet of water about a mile in diameter, the northern side of which is formed by high bare rounded hills of granite, while most of those on the south-east side appear to be of similar character. An island near the south side of the lake is composed of fine-grained greywacke, highly charged with pyrites, the surface being in places weathered to a rusty porous mass.

From the eastern side of this little lake the river flows with moderate current, between granite hills for three-quarters of a mile, and then it leaves the granite and for another three quarters of a mile to Wekusko falls flows over a country underlain by a fine-grained green schist, probably a squeezed and altered gabbro, though the surface is generally overlain by a thin coating of clay.

Wekusko falls have a total descent of forty-five feet, over green altered gabbro. Wekusko lake, which extends eastwards from the foot of the falls, is a beautiful expanse of moderately clear water with bold rocky shores. At its southern end the escarpment of Trenton rocks rises to a height of fifty feet. The upper twenty-five feet of this escarpment consists of mottled salmon-coloured and yellow Trenton limestone, weathering to a light red, heavily and horizontally bedded. It is very much fractured along numerous jointage planes, and large angular masses have slid forward or have pulled down the face of the cliff, so that the limestone is evidently underlain by a more friable layer, doubtless the basal sandstone.

Fossils are scarce and badly preserved, but the following were collected or recognized in place—*Receptaculites Oreni*, small crinoid stems, *Columnaria alveolata*, *Palaeophyllum rugosum*, *Calapacia Canadensis*, *Stictopora acuta*, *Orthis testudinaria*, *Maclurea Manitobensis*, and a large form of *Tripteroceras Lambii*. The limestone skirts the shore for four miles, but some low points and outlying islands are composed of massive or schistose green chloritic rock, probably a squeezed and highly altered diabase. The schistose portions are more or less vertical and strike northwards. On the eastern shore of the lake for four miles north of the limestone escarpment, the points and adjoining islands consist of similar green chloritic schist cut by many quartz veins, behind which is a massive even-grained red granite, that occa-

sionally shows traces of foliation near the line of contact with the schist. North of this for seven miles this shore was not examined.

On the western shore north of the limestone escarpment is a terrace twenty feet high, of sand and boulders, from beneath which crop out low bosses of chloritic and sericitic schist. A mile and a half from the limestone the schist comes in contact with a massive rather fine-grained diorite. Close to the contact the diorite contains such a large number of angular fragments of schist as to give it a definitely schistose character. From there northward to the next deep bay the shore is composed of bold cliffs from twenty to fifty feet high, of massive diorite, consisting of plagioclase in large amount, hornblende, a light-green variety, very slightly pleochroic; a few scales of biotite in which is included a small amount of iron ore; the principal jointage planes always dipping towards the lake at a high angle. In places the diorite is highly charged with pyrite.

North of the deep bay the shore is not so high and in many places the twenty feet clay terrace is quite clearly defined. On the lee sides of the rocky hills there is often a little till, consisting of a mixture of sand and clay. The rock is generally a compact, much jointed, thin, foliated green schist.

Contact forms  
northern  
terminations  
of granite  
mass.

This schist extends northward along the shore, past the mouth of Grass river, to the mouth of Notaminihewi or Berry-hunting river, where it comes in vertical contact with a massive coarse-grained red hornblende granite. Along the line of contact the schist is baked into a very hard light-gray quartzitic schist. This would seem to be the northern termination of the granite mass that has been described as extending for a considerable distance along the west side of Grass river. Here glacial striae may be distinctly seen running S. 15° W. North-eastward from Berry river for five miles down the shore, the rock seems to be everywhere either an altered schistose diabase, or a fine-grained green clastic schist or greywacke.

The islands in the bay off the mouth of Wekusko brook seem to be of altered diabase, while the points on the adjoining east shore are composed of a fine-grained slightly foliated rock, probably an altered diabase or feldspathic sandstone. Off Wekusko point are some small islands apparently on the line of a dyke of coarse diabase, while the shore is composed of a light-green chloritic schist. Two miles east of Wekusko point, where the lake contracts to half a mile in width, the shore is composed of a dark-gray staurolite schist, with vertical dip and striking N. 45° E. Behind it are steep cliffs of coarse gabbro,

approaching a diabase in structure. This gabbro contains large idiomorphic crystals of plagioclase up to about two inches in length with allotriomorphic crystals of plagioclase, perhaps of slightly different composition in the groundmass. On the eastern shore are steep cliffs of a schistose or massive dark-green squeezed diabase.

For three miles and a half north-eastward, the coarse porphyritic gabbro continues to form a steep bare cliff along the north-western shore, while at the foot of the cliff the staurolite schist may be seen here and there near the edge of the water. In places near the contact of these two rocks, fragments of the schist are included in the gabbro, showing clearly the irruptive nature of the contact.

Irruptive  
nature of  
contact  
evident.

The cliff of coarse gabbro then recedes from the west shore, and a sandy terrace takes its place. The low points and islands are of staurolite schist cut by wide dykes of coarse red and white pegmatitic granite. At one point the red granite was found to contain large crystals of tourmaline and muscovite, and a considerable quantity of arsenical pyrites.

Nine miles below the main body of Wekusko lake are several small houses on the east shore, where some families of Indians usually pass the winter. Behind this winter village is a steep ridge one hundred and twenty feet high, consisting of thinly foliated gray micaceous gneiss striking N. 45° E. and dipping more or less vertically. It is cut by many irregular veins of white quartz, and by wide veins, running nearly along the strike of the gneiss of a coarse white or reddish granite, containing large idiomorphic crystals of orthoclase, and also crystals of white and black mica.

The surface on the summit of this ridge is scored by parallel glacial grooves running S. 18° W. All the hollows on the summits are filled with soft brownish clay. The thinly foliated micaceous, often staurolitic, schist, seemed to strike N.N.E. down the middle of the straight valley occupied by the river, but its exact relationship to the surrounding gneiss was not determined.

At the mouth of Wuskatasko (or Carrot) creek, Grass river turns sharply eastward for two miles, measured in a straight line, passing through a low ridge of evenly foliated gray gneiss striking N. 15° E., 40° E. At the end of the two miles the river strikes the foot of a high bare ridge of thinly foliated fine-grained biotite schist, with crystals of staurolite striking N. 30° E., 75° E. It is not improbable that this ridge of schist forms the eastern side of an anticlinal fold, and that the band of schist followed a short distance further up the

Anticlinal  
fold.

river forms its western side, while the central portion overlying the gneiss has been denuded away. Where the river breaks through this ridge of schist it forms three heavy rapids, past the upper two of which are portages, respectively ninety and seventy yards in length.

Below these rapids the banks for a mile and a half are formed of a more or less open terrace from ten to fifteen feet above the water. Then the river turns sharply and flows for five miles southward on the east side of a high ridge of dark-green schist, probably altered diabase. From the foot of the ridge it swings round again in an easy curve towards the north east, passing some hills of dark-green highly altered diabase which rise in the middle of a wooded valley.

River leaves  
Huronian  
area.

At or near these hills the river leaves the Huronian area, through which it has flowed all the way from its source, and enters a country of lower surface contour, underlain by Laurentian granites and gneiss, though these rocks are usually hidden by stratified Lake Agassiz clays. From the bend the river winds between low reedy clay banks for seven miles to a series of three rapids with descents of twelve, fifteen and eight feet respectively, over gray or reddish gneiss with a strike N. 50° E., and a dip approaching more or less nearly to the vertical. The second and third of these rapids are known to the Indians as Kanisota (or the Two) rapids.

For ten miles below Kanisota rapids, the river has a gentle current and flows between sloping banks of light-gray clay wooded with white and black spruce and Banksian pine. The surrounding country seemed to be a level clay plain, more or less completely covered with swamp.

Western limit  
of Labrador-  
ian glacier.

At Wapikwachew (or White Forest) rapid is a barrier of medium-grained light-gray garnetiferous granite, and a similar, though lighter coloured granite again outcrops at Stickago (Skunk) rapid, three miles and a half further down the stream. The surface of the rock here is strongly marked by striae and grooves of the Keewatin glacier trending S. 40° W. A mile and a half down stream is Wapichtigow (White-wood) falls, one of the highest on the river, where the water tumbles forty feet over a ridge of evenly foliated dark-gray hornblende gneiss striking N. 5° E. and with vertical dip. In places the gneiss is highly garnetiferous, some of the garnets being very clear and bright. The general surface of the gneiss is strongly scored by striae of the Keewatin glacier trending S. 42° W., but some of the more prominent faces sloping eastward show the later grooves and striae of the Labradorian glacier trending S. 88° W., clearly marking a point near the extreme western limit of this latter glacier.

For three miles further to the mouth of Metishto river, the river continues to flow with decreasing current which is interrupted by two slight rapids over reddish or gray gneiss. Metishto (Sweat tent) river is stated to rise within a short distance of the north-west arm of Moose lake, and to flow northward with a gentle current to within a few miles of Wekusko lake, below which it is a narrow rapid stream difficult to navigate with canoes. From here to Setting lake, Grass river is wide and currentless with greenish milky water. A short distance below the mouth of Metishto river it crosses the end of Metishto lake, which has rocky shores, and then it continues north-north-eastward for seven miles in a straight valley a quarter of a mile wide between wooded ridges of gneiss, the banks of the channel being everywhere low and marshy. It then turns eastward and cuts across the north end of Pakwahigan lake. Where the river leaves this lake is a low rocky point composed of gray regularly foliated gneiss striking N. 50° E., and with vertical dip. Some of the thicker bands are cut by veins of red pegmatite in which are large crystals of hematite. The surface is generally scored by grooves of the Labradorian glacier running S. 83° W.

A similar gneiss, but striking N. 15° E. outcrops at the point of discharge of the river into Setting lake.

Setting lake, or as it is locally known John Scotts' lake, is a long and comparatively narrow body of light brownish water, extending in a north-easterly and south-westerly direction. Its south-western end was not examined. The widest portion of its northern end is divided longitudinally by a chain of gneissic islands. The shores are for the most part composed of a beach of smooth grey gneiss striking with the long axis of the lake, overlain by a few feet of clay, which is wooded with a forest of small poplar or spruce and larch, much of which has been destroyed by fire.

Near the end of a long point on a sandy delta-like terrace, ten feet above the water, stands an old double chimney of mud and stones, still in a very perfect condition, marking the site of an old fur-trading post or station. The rest of the house or houses have entirely disappeared and the site is completely overgrown with large spruce trees, quite indistinguishable from those of the surrounding forest. In many other instances the sites of the ancient fur-trading posts could be recognized as small, usually rectangular, poplar covered areas, in the midst or on the border of the adjoining forest.



About north latitude  $55^{\circ} 9'$  Grass river flows out of the north-east end of Setting lake over Sasagiu (or Golden Eagle) rapid, which has a descent of twelve feet. The rock is a reddish-gray gneiss striking N.  $15^{\circ}$  E. and dipping N.  $75^{\circ}$  W. at an angle of  $30'$ . Below this rapid the river opens into another small lake four miles long, the western shore of which is composed of vertical thinly foliated dark-gray hornblende gneiss, interfoliated with bands of medium-grained white granite. At the foot of the lake is Pisew or Lynx falls, with a descent of fifty feet, first over an abrupt fall and afterwards down a steep broken rapid in a narrow rocky channel.

Below Pisew falls the river flows in a very direct course north-north-eastward for twenty-three miles to the south end of Paint or Nanu-minan lake, though for most of the distance it is without appreciable current. Generally speaking, it follows the strike of the gneiss except at the rapids where it crosses ridges of gneiss. Its banks usually rise in gently rounded slopes to heights of about a hundred feet, and consist of rocky ridges of gneiss covered with a thin coating of soft brownish clay without pebbles or boulders. The summits and sides of these hills are generally wooded with small poplar, but through the poplar and down close to the bank of the stream are some scattered groves of large white spruce.

On the shores of Setting lake and along the banks of the river below it, the surface of the gneiss has been well-smoothed, and is generally scored by grooves and striae of the Labradorian glacier trending a few degrees south of west, but in a few protected localities striae of the Keewatin glacier were also found trending S.  $41^{\circ}$  —  $44^{\circ}$  W.